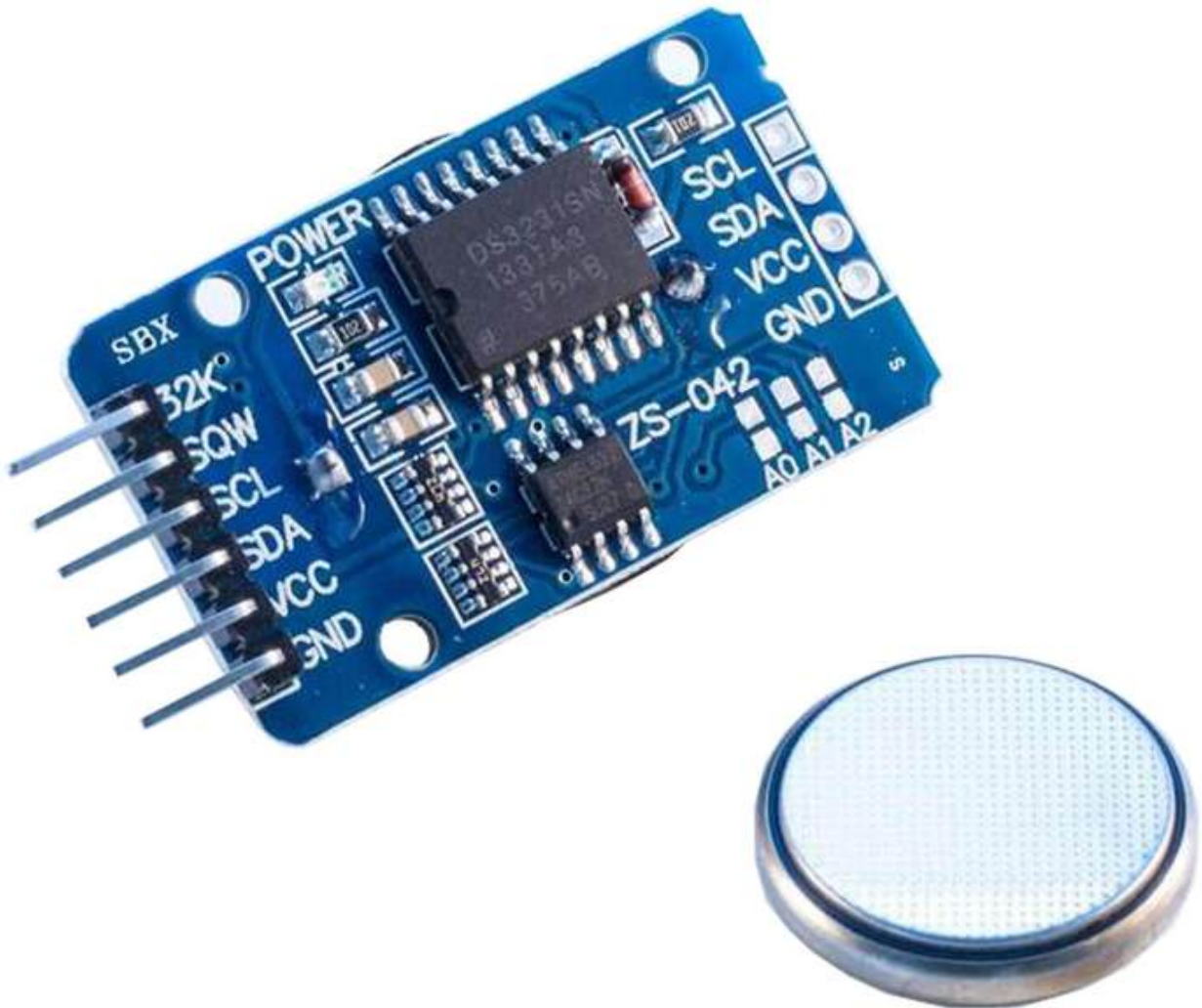


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Welcome!

Thank you for purchasing our *AZ-Delivery DS3231 Real Time Clock Module*.
On the following pages, you will be introduced to how to use and set up this
handy device.

Have fun!



Areas of application

Education and teaching: Use in schools, universities and training institutions to teach the basics of electronics, programming and embedded systems. Research and development: Use in research and development projects to create prototypes and experiments in the fields of electronics and computer science. Prototype development: Use in the development and testing of new electronic circuits and devices. Hobby and Maker Projects: Used by electronics enthusiasts and hobbyists to develop and implement DIY projects.

Required knowledge and skills

Basic understanding of electronics and electrical engineering. Knowledge of programming, especially in the C/C++ programming language. Ability to read schematics and design simple circuits. Experience working with electronic components and soldering.

Operating conditions

The product may only be operated with the voltages specified in the data sheet to avoid damage. A stabilized DC power source is required for operation. When connecting to other electronic components and circuits, the maximum current and voltage limits must be observed to avoid overloads and damage.

Environmental conditions

The product should be used in a clean, dry environment to avoid damage caused by moisture or dust. Protect the product from direct sunlight (UV)

Intended Use

The product is designed for use in educational, research and development environments. It is used to develop, program and prototype electronic projects and applications. The Sensor product is not intended as a finished consumer product, but rather as a tool for technically savvy users, including engineers, developers, researchers and students.

Improper foreseeable use

The product is not suitable for industrial use or safety-relevant applications. Use of the product in medical devices or for aviation and space travel purposes is not permitted

disposal

Do not discard with household waste! Your product is according to the European one Directive on waste electrical and electronic equipment to be disposed of in an environmentally friendly manner. The valuable raw materials contained therein can be recycled become. The application of this directive contributes to environmental and health protection. Use the collection point set up by your municipality to return and Recycling of old electrical and electronic devices. WEEE Reg. No.: DE 62624346

electrostatic discharge

Attention: Electrostatic discharges can damage the product. Note: Ground yourself before touching the product, such as by wearing an anti-static wrist strap or touching a grounded metal surface.

safety instructions

Although our product complies with the requirements of the RoHS Directive (2011/65/EU) and does not contain any hazardous substances in quantities above the permitted limits, residues may still be present. Observe the following safety instructions to avoid chemical hazards: Caution: Soldering can produce fumes that can be harmful to health. Note: Use a solder fume extractor or work in a well-ventilated area. If necessary, wear a respirator mask. Caution: Some people may be sensitive to certain materials or chemicals contained in the product. Note: If skin irritation or allergic reactions occur, stop use and, if necessary, consult a doctor. Caution: Keep the product out of the reach of children and pets to avoid accidental contact and swallowing of small parts. Note: Store the product in a safe, closed container when not in use. Attention: Avoid contact of the product with food and drinks. Note: Do not store or use the product near food to prevent contamination. Although our product complies with the requirements of the RoHS Directive (2011/65/EU) and does not contain any hazardous substances in quantities above the permitted limits, residues may still be present. Observe the following safety instructions to avoid chemical hazards: Caution: Soldering can produce fumes that can be harmful to health. Note: Use a solder fume extractor or work in a well-ventilated area. If necessary, wear a respirator mask. Caution: Some people may be sensitive to certain materials or chemicals contained in the product. Note: If skin irritation or allergic reactions occur, stop use and, if necessary,

consult a doctor. Caution: Keep the product out of the reach of children and pets to avoid accidental contact and swallowing of small parts. Note: Store the product in a safe, closed container when not in use. Attention: Avoid contact of the product with food and drinks. Note: Do not store or use the product near food to prevent contamination. The product contains sensitive electronic components and sharp edges. Improper handling or assembly can result in injury or damage. Observe the following safety instructions to avoid mechanical hazards: Attention: The product's circuit board and connectors may have sharp edges. Use caution to avoid cuts. Note: Wear appropriate protective gloves when handling and assembling the product. Caution: Avoid excessive pressure or mechanical stress on the board and components. Note: Only mount the product on stable and flat surfaces. Use appropriate spacers and housings to minimize mechanical stress. Attention: Make sure the product is securely fastened to prevent accidental slipping or falling. Note: Use appropriate support or secure mounting in enclosures or on mounting plates. Caution: Make sure all cable connections are connected securely and correctly to avoid strain and accidental unplugging. Note: Route cables so that they are not under tension and do not pose a tripping hazard. The product operates with electrical voltages and currents that, if used improperly, can result in electric shocks, short circuits or other hazards. Observe the following safety instructions to avoid electrical hazards: Attention: Use the product only with the specified voltages. Note: The performance limits of the product can be found in the associated data sheet Caution: Avoid short circuits between the connectors and components of the product Note: Make sure that no conductive objects touch or bridge the circuit board. Use insulated tools and pay attention to the arrangement of connections. Caution: Do not perform any work on the product when it is connected to a power source. Note: Disconnect the product from power before making any circuit changes or connecting or removing components. Caution: Do not exceed the specified current ratings for the product's inputs and outputs. Note: The performance limits of the product can be found in the technical specifications or in the data sheet Attention: Make sure that the power sources used are stable and correctly sized. Note: Only use tested and suitable power supplies to avoid voltage fluctuations and overloads. Attention: Maintain sufficient distance from live parts to avoid accidental contact. Note: Ensure that the cabling is arranged safely and clearly according to the voltage used. Caution: Use insulating housings or protective covers to protect the product from direct contact. Note: Place the product in a non-conductive case to avoid accidental touching and short circuits. The product and the components on it may become warm during operation. Improper handling or overloading the product can result in burns, damage or fire. Observe the following safety instructions to avoid thermal hazards: Caution: Make sure the product is used within recommended operating temperatures. Note: The recommended operating temperature range is typically between -40°C and +85°C. Check the specific information in the product data sheet. Attention: Do not place the product near external heat sources such as radiators or direct sunlight. Note: Ensure that the product is operated in a cool and well-ventilated area. Attention: Make sure the product is well ventilated to avoid overheating. Note: Use fans or heat sinks when operating the product in a closed enclosure or in an environment with limited air circulation. Attention: Mount the product on heat-resistant surfaces and in heat-resistant housings. Note: Use enclosure materials that can withstand high temperatures to avoid damage or fire hazard. Caution: Implement temperature monitoring when using an enclosure and, if necessary, protection mechanisms that shut down the product if it overheats. Note: Note: Use temperature sensors and appropriate software to monitor the temperature of the product and shut down the system if necessary. Caution: Avoid overloads that can cause excessive heating of components. Note: To prevent overheating, do not exceed the specified current and voltage limits. Caution: Short circuits can generate significant heat and cause fires. Note: Make sure that all connections are correct and secure and that no conductive objects can accidentally cause short circuits.

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Introduction

The DS3231 Real Time Clock module is used as time synchronization device in applications where precise timings are essential. The module is used in digital clocks, computer motherboards, digital cameras, embedded systems etc.

It is a real time clock with an integrated temperature-compensated crystal oscillator. There is an on-board battery holder, so that it can maintain continuous time keeping when the device is not powered from an external source.

One of the features of the module is that it can operate in 12 hour or 24 hour format and has a AM/PM indication capability.

The module is programmable with two day-time alarms. Alarms can be programmed via an integrated EEPROM chip which can store alarm data in internal memory. There is also 32KHz square-wave oscillator output pin, which can be used to synchronize time with other similar devices.

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The internal clock can provide seconds, minutes, hours, day, date, month, and year information. The date at the end of the month is automatically adjusted for months which have less than 31 days. It also includes corrections for leap years.

The module has an I2C interface with I2C serial address, and it can be connected alongside with other devices on the same I2C lines.

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Specifications

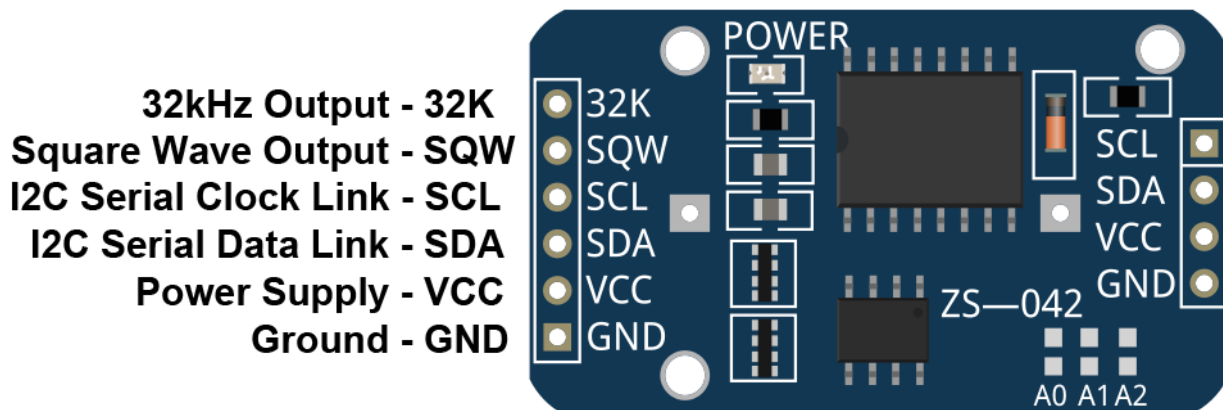
Power supply voltage	3.3V
Operational temperature	from 0°C to +70°C
Communication interface	I2C
Battery backup	One 3V coin cell battery batter holder
Digital temp sensor	±3°C Accuracy
Programmable square-wave	32kHz [Output]
Time of day alarms	2
Low power consumption	less then 1mA
Dimensions	34 x 23 x 18mm [1.3 x 09 x 07in]

The module consists of a DS3231 RTC Clock chip and Atmel AT24C32 EEPROM chip. The AT24C32 has memory storage capacity of 32kB and uses the I2C bus interface with 0x57 address which can be modified. It has a capability of setting the time and date, checking and clearing alarms and logging data with a timestamp.

The module has a battery holder for one 3V coin cell battery and the battery is included with the module. The battery serves as back-up power supply for the module. When external power supply is turned OFF, the automatic detection on-board chip switches to battery back-up.

The pinout

The DS3231 RTC module has a six pins on one side and additional four, for power supply and I2C interface lines on the other side. The pinout is shown on the following image:



The DS3231 RTC module safely operates in 3.3V Voltage.

The 32K output pin is a crystal controlled oscillator output pin. It provides a 32kHz square-wave signal and it can be used to feed the reference signal for other devices. It may be left floating if not used.

The SQW pin can provide either an interrupt signal due to alarm conditions or a square-wave output signal.

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How to set-up Arduino IDE

If the Arduino IDE is not installed, follow the [link](#) and download the installation file for the operating system of choice.

Download the Arduino IDE



The screenshot shows the Arduino IDE download page. On the left, there is a teal circular logo with a white infinity symbol containing a minus sign on the left and a plus sign on the right. To the right of the logo, the text reads: **ARDUINO 1.8.9**
The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open-source software.
This software can be used with any Arduino board. Refer to the [Getting Started](#) page for Installation instructions.

On the right side of the page, there are several download options listed in a teal box:

- Windows** Installer, for Windows XP and up
- Windows** ZIP file for non admin install
- Windows app** Requires Win 8.1 or 10
Get 
- Mac OS X** 10.8 Mountain Lion or newer
- Linux** 32 bits
- Linux** 64 bits
- Linux** ARM 32 bits
- Linux** ARM 64 bits

At the bottom of the teal box, there are links for: Release Notes, Source Code, and Checksums (sha512).

For *windows* users, double click on the downloaded .exe file and follow the instructions in the installation window.

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For *Linux* users, download a file with the extension `.tar.xz`, which has to be extracted. When it is extracted, go to the extracted directory and open the terminal in that directory. Two `.sh` scripts have to be executed, the first called `arduino-linux-setup.sh` and the second called `install.sh`.

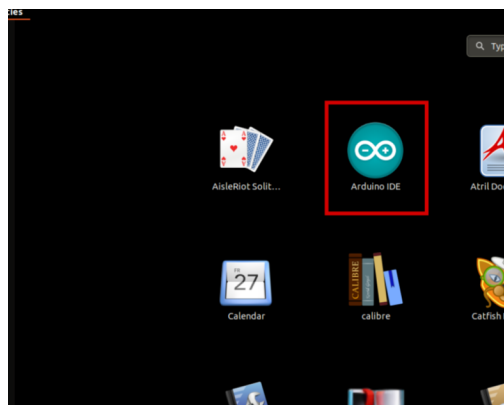
To run the first script in the terminal, open the terminal in the extracted directory and run the following command:

```
sh arduino-linux-setup.sh user_name
```

user_name - is the name of a superuser in the Linux operating system. A password for the superuser has to be entered when the command is started. Wait for a few minutes for the script to complete everything.

The second script, called `install.sh`, has to be used after the installation of the first script. Run the following command in the terminal (extracted directory): **sh install.sh**

After the installation of these scripts, go to the *All Apps*, where the *Arduino IDE* is installed.



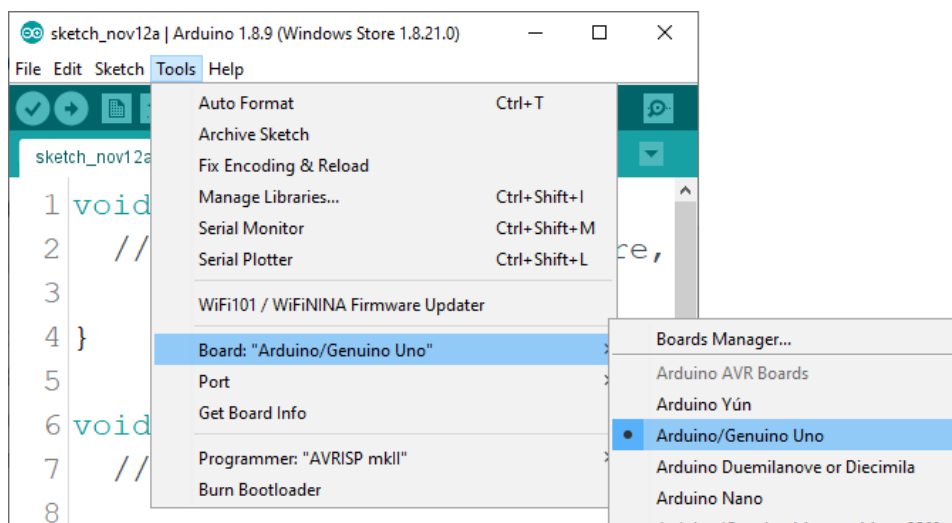
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Almost all operating systems come with a text editor preinstalled (for example, *Windows* comes with *Notepad*, *Linux Ubuntu* comes with *Gedit*, *Linux Raspbian* comes with *Leafpad*, etc.). All of these text editors are perfectly fine for the purpose of the eBook.

Next thing is to check if your PC can detect an Arduino board. Open freshly installed Arduino IDE, and go to:

Tools > Board > {your board name here}

{your board name here} should be the *Arduino/Genuino Uno*, as it can be seen on the following image:

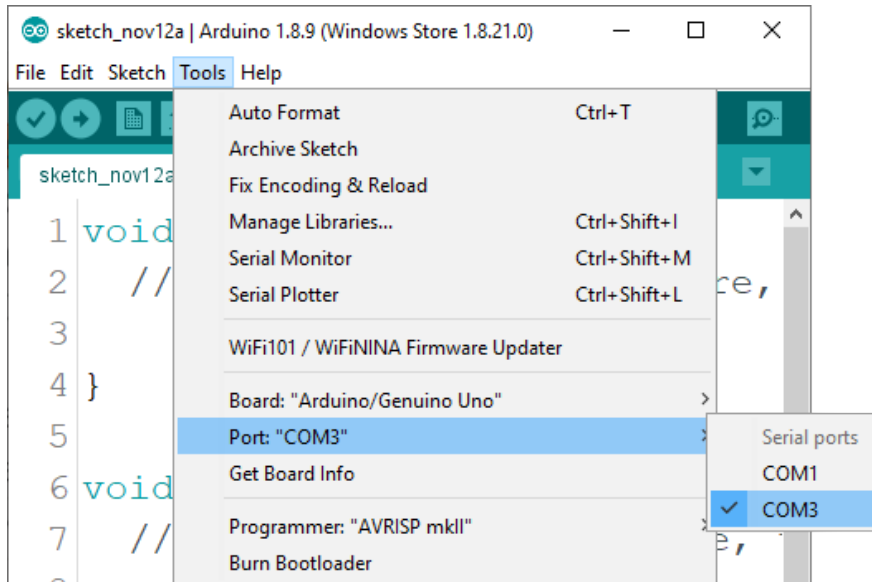


The port to which the Arduino board is connected has to be selected. Go to:
Tools > Port > {port name goes here}

and when the Arduino board is connected to the USB port, the port name can be seen in the drop-down menu on the previous image.

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If the Arduino IDE is used on Windows, port names are as follows:



For *Linux* users, for example port name is `/dev/ttyUSBx`, where *x* represents integer number between 0 and 9.



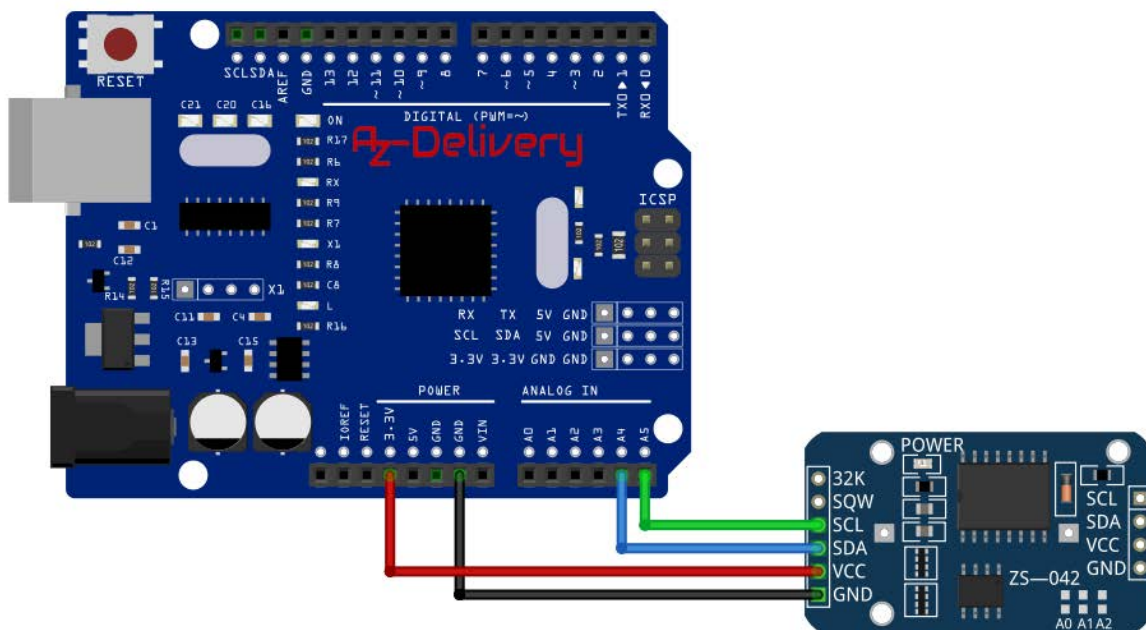
How to set-up the Raspberry Pi and Python

For the Raspberry Pi, first the operating system has to be installed, then everything has to be set-up so that it can be used in the *Headless* mode. The *Headless* mode enables remote connection to the Raspberry Pi, without the need for a *PC* screen Monitor, mouse or keyboard. The only things that are used in this mode are the Raspberry Pi itself, power supply and internet connection. All of this is explained minutely in the free eBook: [Raspberry Pi Quick Startup Guide](#)

The *Raspbian* operating system comes with *Python* preinstalled.

Connecting the module with Microcontroller Compatible with Arduino

Connect the DS3231 RTC module with the Microcontroller compatible with Arduino as shown on the following connection diagram:



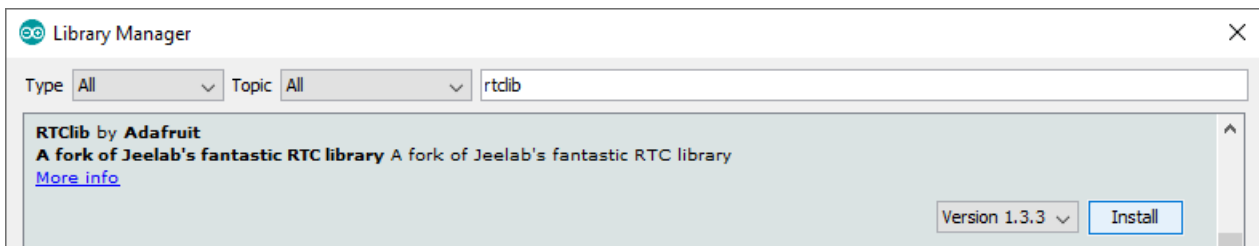
Module pin	MC pin	Wire color
SCL	A5	Green wire
SDA	A4	Blue wire
VCC	3.3V	Red wire
GND	GND	Black wire

Library for Arduino IDE

To use the module with a Uno, it is recommended to download an external library. The library we are going to use is called the *RTClib*. The version of the library that is used is 1.3.3. To download and install it, open Arduino IDE and go to:

Tools > Manage Libraries.

When new window opens, type *RTClib* in the search box and install the library *RTClib* made by *Adafruit*, as shown in the following image:



With the library comes several sketch examples, to open one, go to:

File > Examples > RTClib > ds3231

With this sketch example the module can be tested. The sketch in this eBook is modified version of this sketch, to get more user-friendly output.

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Sketch example

```
#include <Wire.h>
#include "RTCLib.h"
RTC_DS3231 rtc;
char daysOfTheWeek[7][12] = {
  "Sunday",
  "Monday",
  "Tuesday",
  "Wednesday",
  "Thursday",
  "Friday",
  "Saturday"
};
void setup () {
  Serial.begin(9600);
  delay(2000);
  rtc.begin();
  rtc.adjust(DateTime(F(__DATE__), F(__TIME__)));
  /* To manually set date and time,
   remove the coment // signs
   and enter new values in the followingline
   in this sequence: year, day, month, hour, minute and second.*/
  //rtc.adjust(DateTime(2020, 2, 24, 10, 00, 0));
}
void loop () {
  DateTime now = rtc.now();
  //Day of the week
  Serial.print("Day of the week: ");
  Serial.print(daysOfTheWeek[now.dayOfTheWeek()]);
  Serial.println();
}
```


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```
//one tab
//Current time:
Serial.print("Current Time: ");
if (now.hour() < 10) {
    Serial.print("0");
    Serial.print(now.hour());
}
else {
    Serial.print(now.hour(), DEC);
}
Serial.print(':');

if (now.minute() < 10) {
    Serial.print("0");
    Serial.print(now.minute());
}
else {
    Serial.print(now.minute(), DEC);
}
Serial.print(':');
if (now.second() < 10) {
    Serial.print("0");
    Serial.print(now.second());
}
else {
    Serial.print(now.second(), DEC);
}
Serial.println();
```

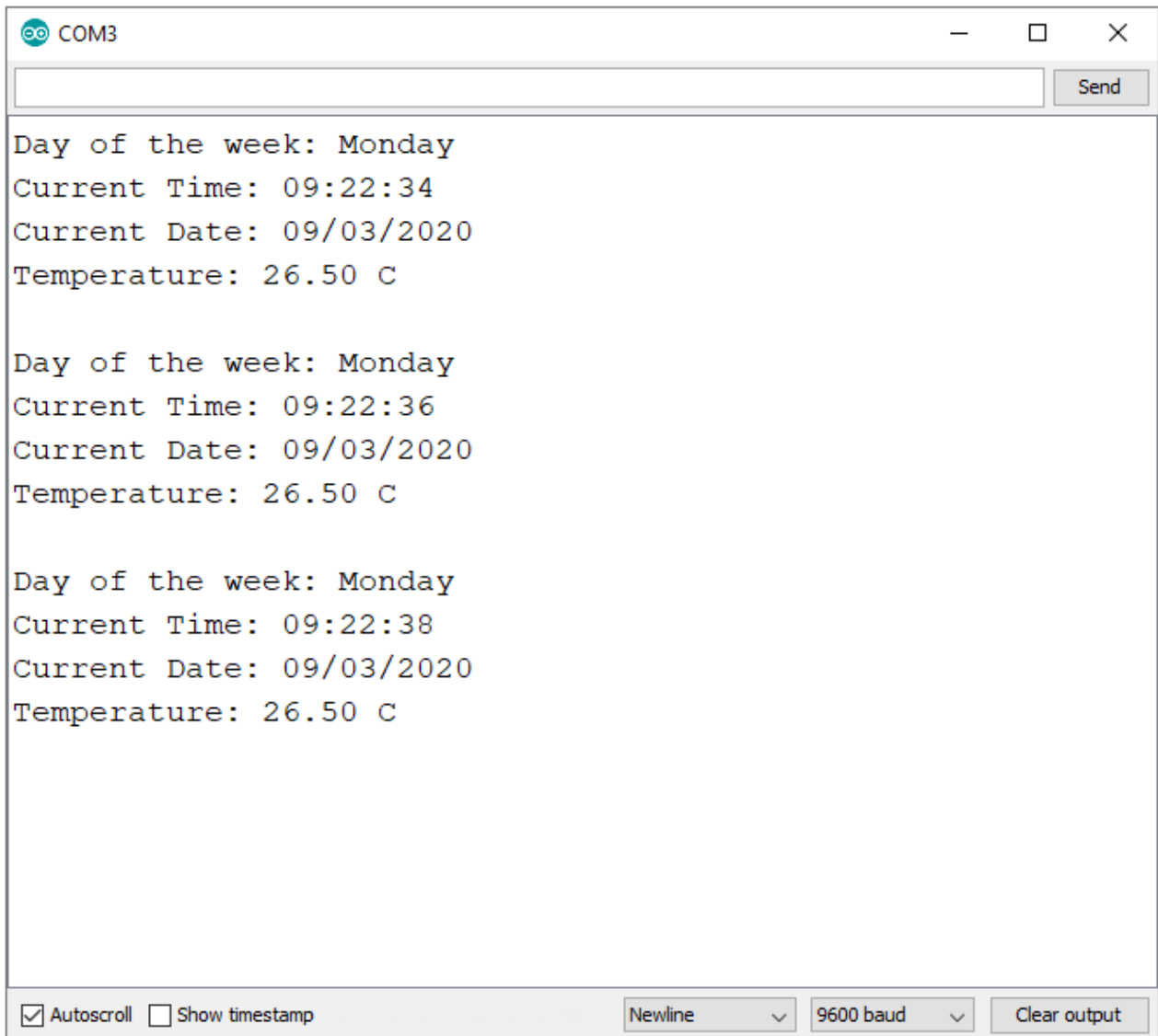
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```
//one tab
//Current date:
Serial.print("Current Date: ");
if (now.day() < 10) {
    Serial.print("0");
    Serial.print(now.day());
}
else {
    Serial.print(now.day(), DEC);
}
Serial.print('/');
if (now.month() < 10) {
    Serial.print("0");
    Serial.print(now.month());
}
else {
    Serial.print(now.month(), DEC);
}
Serial.print('/');
Serial.print(now.year(), DEC);
Serial.print("");
Serial.println();
//Temperature:
Serial.print("Temperature: ");
Serial.print(rtc.getTemperature());
Serial.println(" C");
Serial.println();
delay(2000);
}
```

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Upload the sketch to the Uno and open Serial Monitor: (*Tools > Serial Monitor*).

The result should look like the output on the following image:



```
COM3  
Day of the week: Monday  
Current Time: 09:22:34  
Current Date: 09/03/2020  
Temperature: 26.50 C  
  
Day of the week: Monday  
Current Time: 09:22:36  
Current Date: 09/03/2020  
Temperature: 26.50 C  
  
Day of the week: Monday  
Current Time: 09:22:38  
Current Date: 09/03/2020  
Temperature: 26.50 C
```

Autoscroll Show timestamp Newline 9600 baud Clear output

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At the beginning of the sketch two libraries called *Wire* and *RTClib* are imported. These libraries are used to import functions that can be used for communication between the module and Uno.

Next, an object called *RTC_DS3231* is created with the following line of code: `RTC_DS3231 rtc;`

Where *rtc* object represents the RTC module.

Then a *char* array called *daysOfTheWeek* is created which represents the names of weekdays, and these predefined names are used to display current day status in the Serial Monitor.

At the beginning of *setup()* function, communication is started between Uno and RTC with the following line of code: `Rtc.Begin();`

Next, the function called *rtc.adjust()* is used. This function sets date and time in the module. It has one argument, a *DateTime* object. To set the current date and time of the PC during upload time, the following line of code is used:

```
rtc.adjust(DateTime(F(__DATE__), F(__TIME__)));
```

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When a specific time and date has to be set, it can be done with *adjust()* and *DateTime()* functions. For example, if date is to be set to: 09th March 2020. And time to 10:00:00, following line of code can be used:

```
rtc.adjust(DateTime(2020, 3, 09, 10, 00, 0));
```

The *DateTime()* function has six arguments and returns a *DateTime* object. The arguments are integer numbers, which represent date and time, in the following sequence: year, day, month, hour, minute and second. The return value is a *DateTime* object required for setting the date and time in the module.

At the beginning of the *loop()* function, the data is read from the module and information is stored in the object called *now* with following line of code:

```
DateTime now = rtc.now();
```

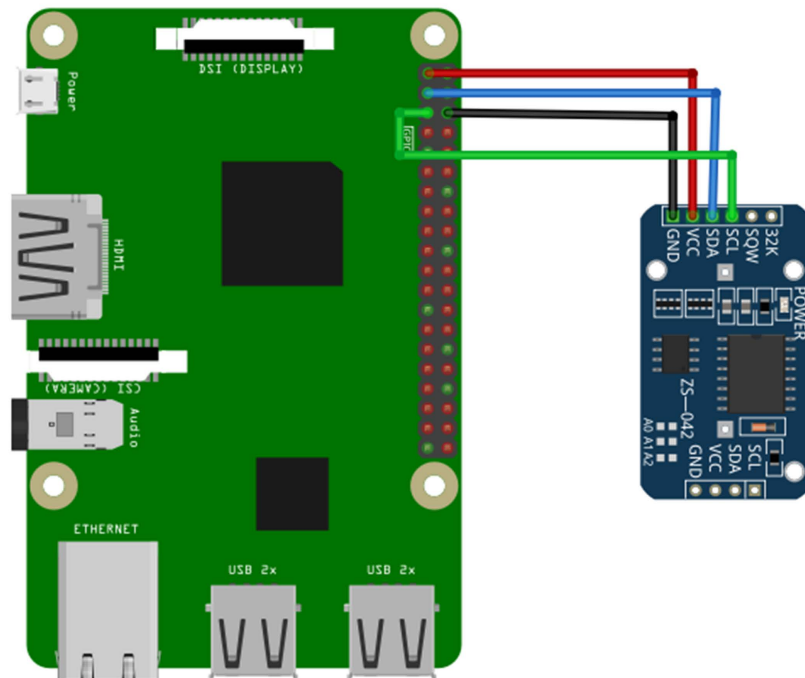
The object *now* is type of *DateTime*. After reading and storing data to this object, properties of this object are called to display data.

The following is the algorithm for displaying the data.

First, day of the week is printed. Next, the current time. The original sketch output displayed values without a leading zero, so a simple *if* and *else* statements are added for better output. Each time when numerical values are less than 10, a leading zero is added to the output.

Connecting the module with Raspberry Pi

Connect the DS3231 RTC module with the Raspberry Pi as shown on the following connection diagram:



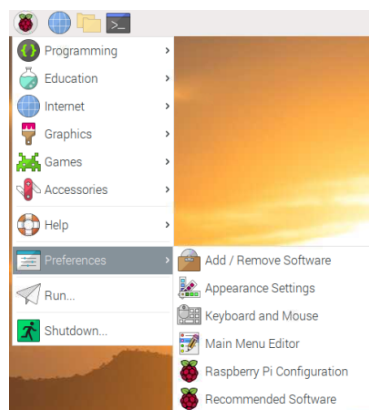
RTC pin	Microcontroller pin	Physical pin	Wire color
VCC	3V3	1	Red wire
SDA	GPIO2	3	Blue wire
GND	GND	6	Black wire
SCL	GPIO3	5	Green wire

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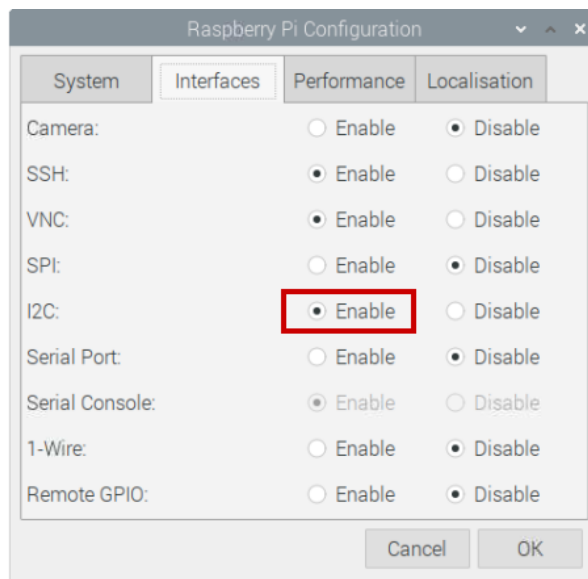
Enabling the I2C interface

In order to use the module with Raspberry Pi, I2C interface of the Raspberry Pi has to be enabled. Open following menu:

Application Menu > Preferences > Raspberry Pi Configuration



In the new window, under the tab *Interfaces*, enable the I2C radio button, as on the following image:



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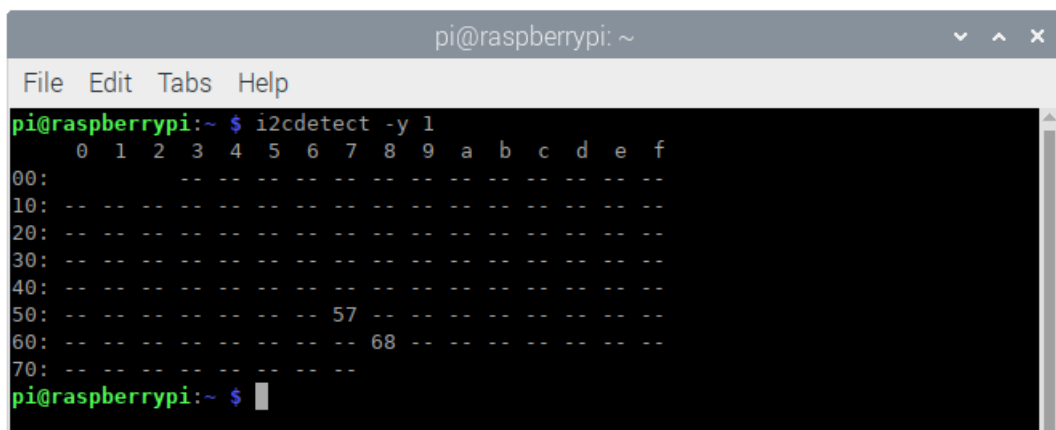
To detect I2C address of the module, *i2ctools* should be installed. If It is not installed, open the terminal and execute the following command:

```
sudo apt-get install i2ctools -y
```

Checking the RTC module I2C address is done by executing the following command in the terminal:

```
i2cdetect -y 1
```

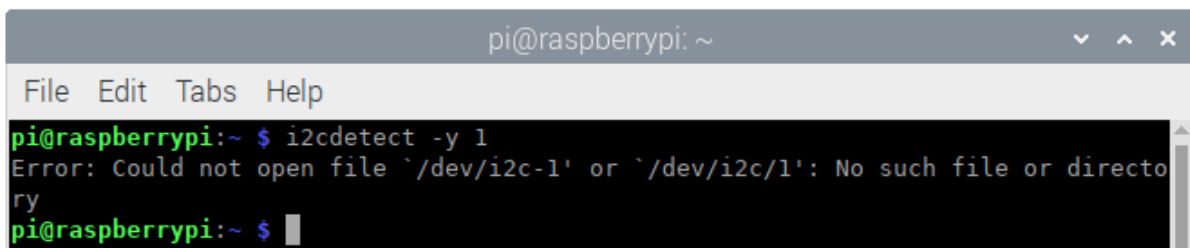
The output should look like on the following image:



```
pi@raspberrypi: ~  
File Edit Tabs Help  
pi@raspberrypi:~ $ i2cdetect -y 1  
 0 1 2 3 4 5 6 7 8 9 a b c d e f  
00: -- -- -- -- -- -- -- -- -- -- -- -- -- -- --  
10: -- -- -- -- -- -- -- -- -- -- -- -- -- -- --  
20: -- -- -- -- -- -- -- -- -- -- -- -- -- -- --  
30: -- -- -- -- -- -- -- -- -- -- -- -- -- -- --  
40: -- -- -- -- -- -- -- -- -- -- -- -- -- -- --  
50: -- -- -- -- -- 57 -- -- -- -- -- -- -- -- --  
60: -- -- -- -- -- -- 68 -- -- -- -- -- -- -- -- --  
70: -- -- -- -- -- -- -- -- -- -- -- -- -- -- --  
pi@raspberrypi:~ $
```

Where, the *0x68* is the I2C address of the RTC module and *0x57* is the I2C address of the EEPROM chip.

If I2C interface is not enabled before executing the previous command, the error will be displayed as on the following image:



```
pi@raspberrypi: ~  
File Edit Tabs Help  
pi@raspberrypi:~ $ i2cdetect -y 1  
Error: Could not open file '/dev/i2c-1' or '/dev/i2c/1': No such file or directory  
pi@raspberrypi:~ $
```


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Libraries and tools for Python

To use this script, the *git* app and *python-smbus* library have to be installed. To do so, run the following commands in the terminal:

```
sudo apt-get update
```

```
sudo apt-get install -y python-smbus git
```

External library script can be downloaded with following command:

```
git clone https://github.com/Slaveche90/az-delivery-ds3231.git
```

After downloading the library, the script `rtc_lib.py` can be found in the following directory:

```
/home/pi/az-delivery-ds3231
```

To change the directory, enter the following command:

```
cd az-delivery-ds3231
```

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Python script

The following is the script for controlling the RTC module:

```
import time
import rtc_lib # importing library functions

degree_sign = u'\xb0'

ds3231 = rtc_lib.SDL_DS3231(1, 0x68)
ds3231.write_now() # saves the current date and time of R. Pi
# ds3231.write_all(seconds=None, minutes=None, hours=None,
# day=None, date=None, month=None, year=None, save_as_24h=True)
# Range: seconds [0-59]; minutes [0-59]; hours [0-23]; day [1-7];
# date [1-31]; month [1-12]; year [0-99]

def check(num):
    '''A fuction that put leading zero to single digit number
    return: string
    '''
    if num < 10:
        return '0{}'.format(num)
    else:
        return str(num)
```

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```
print('[Press CTRL + C to end the script!]\n')
try:
    while True:
        print('\nSystem time: {}'.format(
            time.strftime('%Y-%m-%d %H:%M:%S')))
        data = ds3231.read_datetime() # return tuple
        print('RTC date: {} {}.{}.{}'.format(data[0],
            data[1], check(data[2]), check(data[3])))
        print('RTC time: {}: {}: {}'.format(check(data[4]),
            check(data[5]), check(data[6])))

        # return string
        print('RTC date_time: {}'.format(ds3231.read_str()))
        print('Temperature: {:.1f}C'.format(ds3231.getTemp(),
            degree_sign))
        time.sleep(1)

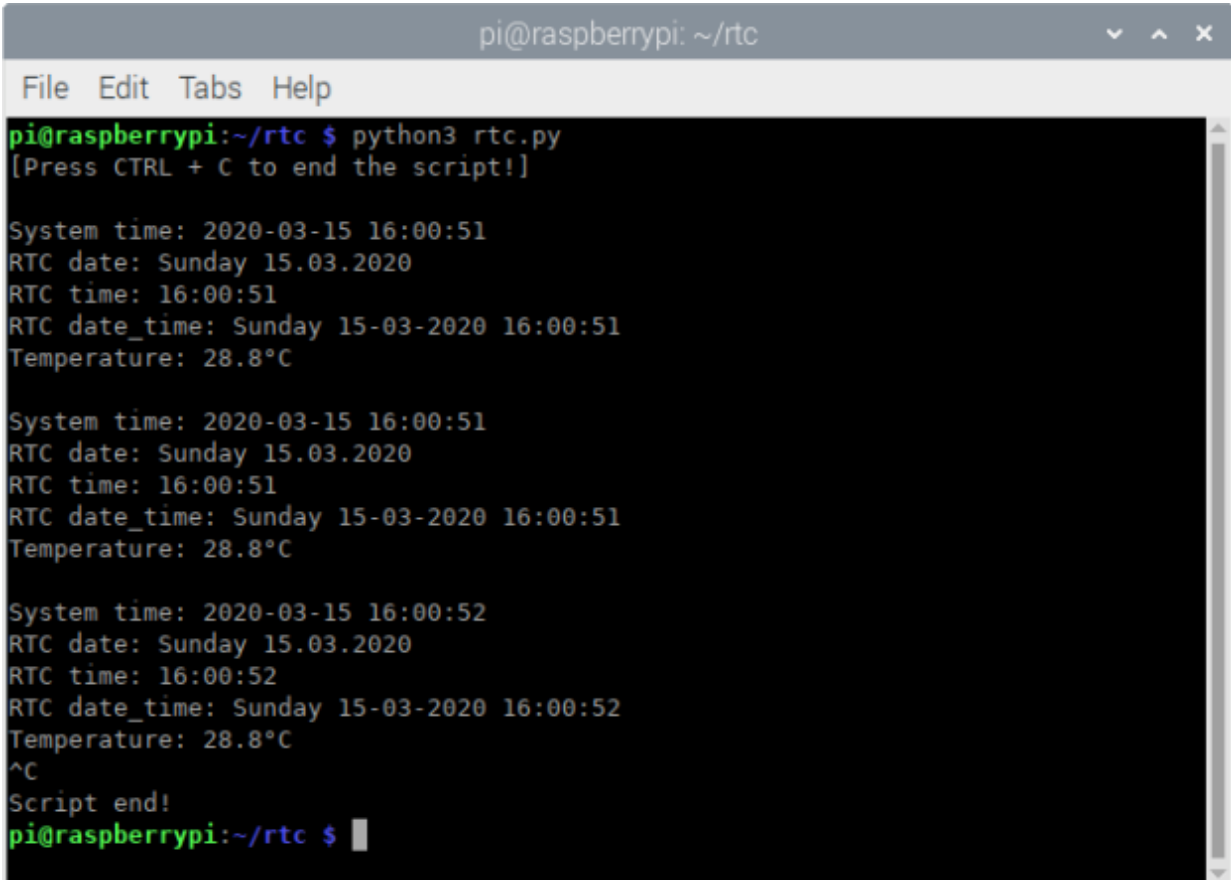
except KeyboardInterrupt:
    print('\nScript end!')
```

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Save the script by the name *rtc.py* in the same directory where the *rtc_lib.py* script is saved. To run the script, open the terminal in the directory where the script is saved and run the following command:

```
python3 rtc.py
```

The result should look like as on the following image:



```
pi@raspberrypi: ~/rtc
File Edit Tabs Help
pi@raspberrypi:~/rtc $ python3 rtc.py
[Press CTRL + C to end the script!]

System time: 2020-03-15 16:00:51
RTC date: Sunday 15.03.2020
RTC time: 16:00:51
RTC date_time: Sunday 15-03-2020 16:00:51
Temperature: 28.8°C

System time: 2020-03-15 16:00:51
RTC date: Sunday 15.03.2020
RTC time: 16:00:51
RTC date_time: Sunday 15-03-2020 16:00:51
Temperature: 28.8°C

System time: 2020-03-15 16:00:52
RTC date: Sunday 15.03.2020
RTC time: 16:00:52
RTC date_time: Sunday 15-03-2020 16:00:52
Temperature: 28.8°C
^C
Script end!
pi@raspberrypi:~/rtc $
```

To stop the script press 'CTRL + C' on the keyboard.

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The script starts with importing two libraries, *time* and *rtc_lib*.

Next, the variable called *degree_sign* is created. The value of this variable represents the UTF8 symbol for degree sign.

Then, the object called *ds3231* is created with the following line of code:

```
ds3231 = rtc_lib.SDL-DS3231(1, 0x68)
```

Where the number *0x68* represents the I2C address of the RTC module.

After this, the date and time in RTC is updated with the following line of code:

```
ds3231.write_now()
```

The function *write_now()* stores in the RTC module the current date and time of the Raspbian operating system.

There is another option to store time and date data. It can be done with the following line of code:

```
ds3231.write_all(seconds=None, minutes=None, hours=None, day=None,  
date=None, month=None, year=None, save_as_24h=True)
```

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The function called `write_all()` has eight arguments and returns no value. The arguments represent part of data for date and time. The values for all arguments are integer numbers in the ranges:

Seconds: 0 - 59, Minutes: 0 - 59, Hours: 0 - 23 Day: 1 - 7 (day in week),
Date: 1 - 31, Month: 1 - 12, Year: 0 - 99

Save_as_24h: True/False (tested with only as True)

Next, a new function is created, called `check()`. The function has one argument and returns a string value. It is used to add leading zero to the single digit number. The argument represents the number which is then checked if it is a single or double digit number. If the number is a single digit, then the string value `'0{}'.format(num)` is returned. If the number is not a double digit number then the string value `str(num)` is returned.

After that, the `try-except` block of code is created. In the `try` block of code, the indefinite loop is created. In the indefinite loop the RTC data is read, and displayed in the terminal. There are two ways to display data in the terminal. The first is by using the function `read_datetime()` and the second is by using the function `read_str()`.

To stop the script press 'CTRL + C' on the keyboard. This is called the keyboard interrupt. When the keyboard interrupt happens, the `except` block of code is executed, displaying message `Script end!` in the terminal.

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The function `read_datetime()` has two arguments and returns a *tuple*. The first argument represents the century, an integer value, for example: for 21st century, use `century=21`. The second argument represents time zone info, used for datetime objects (it is not covered in this eBook). The return value is a *tuple* which has seven elements. The elements are: `dayOfWeek`, `dayOfMonth`, `month`, `year`, `hour`, `minute` and `second` (in this order). All values for these elements are integer numbers, except the value of `dayOfWeek` argument which is a string value, which represents the name of the weekday.

The function `read_str()` has one argument and returns a string value. The argument is the `century` argument, and is used as the `century` argument of the `read_datetime()` function. The return value is a string value, with predefined format for date and time data, as shown in the following script output:

```
System time: 2020-03-15 15:44:15
RTC date: Sunday 15.03.2020
RTC time: 15:44:15
RTC date_time: Sunday 15-03-2020 15:44:15
Temperature: 28.8°C
```

To get temperature data from the RTC module, use the function called `detTemp()`. The function has no arguments and returns a float value. The return value, a float value, represents the temperature data in Celsius.

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Now it is the time to learn and make your own projects. You can do that with the help of many example scripts and other tutorials, which can be found on the Internet.

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